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June 26, 1984

Algy Tamoshunas, Esquire
North American Philips Corporation
580 White Plains Road
Tarrytown, New York 10591

Re: Magnavox v. Activision

Dear Algy:

Enclosed please find a copy of the deposition transcript of John H. Drumheller. This deposition related to the Information Displays, Inc. pool game demonstration at the 1966 Fall Joint Computer Conference which we discussed on the telephone.

As you will see from the transcript, Mr. Drumheller did not recall whether the demonstration used with raster scan or plotting-type display. We are in the process of investigating this matter and will inform you when we have any results.

Very truly yours,

NEUMAN, WILLIAMS, ANDERSON & OLSON

By _____
James T. Williams

JTW:de
Enclosure

cc: T. A. Briody - w/o encl.
L. Etlinger - w/encl.
R. I Seligman - w/encl.
T. W. Anderson - w/o encl.

COPY

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

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THE MAGNAVOX COMPANY, a Corporation, and SANDERS ASSOCIATES, INC., a Corporation,	)	
Plaintiffs,	)	
vs.	)	Civil Action
ACTIVISION, INC., a Corporation,	)	No. C-82-5270-JPV
Defendant.	)	

DEPOSITION OF

JOHN A. DRUMHELLER,

Thursday, May 31, 1984

IRVIN C. SCHEIBE, C.S.R.
18 MOORING LANE
DALY CITY, CA 94014
(415) 994-5483

SPECIALIZING IN PATENTS, TRADEMARKS AND COPYRIGHTS SINCE 1960

CSR #1237
DEPOSITIONS
GENERAL REPORTING

BE IT REMEMBERED that, pursuant to Notice of Taking Deposition, and on Thursday, the 31st day of May, 1984, commencing at the hour of 9:20 a.m. thereof, at the Law Offices of FLEHR, HOHBACH, TEST, ALBRITTON & HERBERT, Four Embarcadero Center #3400, San Francisco, California 94111, before me, IRVIN C. SCHEIBE, a Notary Public in and for the City and County of San Francisco, State of California, there personally appeared

JOHN A. DRUMHELLER

called as a witness, having been first duly sworn by the notary public to tell the truth, the whole truth and nothing but the truth, testified as is hereinafter set forth.

* * *

Messrs. NEUMAN, WILLIAMS, ANDERSON & OLSON, represented by JAMES T. WILLIAMS, Esq., 77 West Washington Street, Chicago, Illinois 60602, appeared as counsel for the plaintiffs.

Messrs. FLEHR, HOHBACH, TEST, ALBRITTON & HERBERT, represented by EDWARD S. WRIGHT, Esq. and WILLIAM CAMMETT, Esq., Four Embarcadero Center #3400, San Francisco, California 94111, appeared as counsel for the defendant.

* * *

EXAMINATION BY MR. WRIGHT:

MR. WRIGHT: Q. Would you state your full name for the record, Mr. Drumheller.

A. John Albert Drumheller.

Q. What is your residence?

A. 16414 South East 44th Place, Issaquah, Washington 98027.

Q. Could you spell Issaquah.

A. I-s-s-a-q-u-a-h.

Q. What is your educational background?

A. Bachelor of Mathematics from MIT, class of '64.

Q. Have you had any courses beyond the Bachelor's Degree?

A. No.

Q. Were you at MIT for four years?

A. Yes.

Q. Did you have any involvement with computers at MIT?

A. Yes.

Q. What was that?

A. Extensive.

Q. Did you have any courses relating to computers?

A. Yes. Probably half my courses.

Q. Did you work with computers?

A. Yes. The PDP-1 in building 26, I think, being the primary one.

Q. What did you do on the PDP-1?

A. Many projects, the primary one being implementing the game of Mill.

Q. What was that?

A. Mill is the Scandinavian equivalent of checkers.

Q. How do you spell Mill?

A. M-i-l-l.

Q. Were there any other games?

A. Yes. In my senior year I probed rather seriously an algorithm for the game of Go which is a very difficult game.

Q. Was this also on the PDP-1?

A. Yes.

Q. Were you involved with any other games at MIT?

A. Well, those two I described. I was the author of several of the courses, one in particular in school 6; that was the point to the course, was to explore artificial intelligence game playing. There was a very tightly related subject at that time called theorum proving which just is another form of search.

Q. Were you familiar with the game called Space War at MIT?

A. Oh, sure. Of course, that was that same PDP-1.

Q. Did you play Space War?

A. Sure. I was there while it was being developed. The guy rubbing shoulders with me was making it.

Q. Who was that?

A. I don't know. There was two guys from Harvard and then some of what we used to call the tech model railroad club, which back then was the hackers of MIT.

Q. What was your first employment after you left MIT?

A. Adams Associates.

Q. When were you at Adams Associates?

A. Well, it would be July of 1964.

Q. How long were you there?

A. Until May of 1967.

Q. What was your position at Adams Associates?

A. I started at the bottom and went to the top. I started off as a programmer and ended up being one of the five guys running the company.

Q. During what period were you a programmer?

A. Well, Adams Associates was literally an association of programmers. So everybody at all times was a programmer. So in a sense your question doesn't work.

Q. When did you first have another position other than a programmer at Adams?

A. It would have been the summer of 1965.

Q. What was that position?

A. I became a project leader. So I started having other programmers underneath me, and more to the point I started working on more than one project simultaneously, managing more than one project.

Q. What was your next position after project leader?

A. Adams Associates would just invent the next title as you took on three projects simultaneously, versus four, five, 10, and I don't remember all the various silly titles.

Q. Do you recall at least some of the programs you worked on at Adams Associates?

A. Sure.

Q. What were those?

A. Let's see if I can vaguely remember them chronologically. The very first one was a matrix inversion for Northrup. The next one was a display program at AFCRL which is an Air Force research laboratory. The next one was a a rocket re-entry program for Wollups Island and Lincoln Laboratories.

Another one was a program called Base Line which was a CRT data analysis program. I did a CALCOMP, generalized CALCOMP plotting package.

Q. How do you spell CALCOMP?

A. C-A-L-C-O-M-P.

Q. Is that one word?

A. Yes. California Computer Products, Inc.

I did a job plotting Mercator maps for Woods Hole Oceanographic Institute. I did a job for a company called Mithras, Inc.

Q. Would you spell that one?

A. M-i-t-h-r-a-s.

Q. What was that project?

A. There were two projects. Both of them were scientific equation problems. One was a set of simultaneous differential equations that just did not want to converge, and the other one was a gas molecule problem, but I don't remember the process details of that. But again it was a mathematical problem.

Then there was the big job at Lincoln Laboratories for about a year and a half. It was leader of what is called PRES optics. PRES stood for Pacific Range Electromagnetic Signature studies. Lincoln Laboratories was the mother contractor for all our antiballistic missile research back then.

Q. When was this project?

A. All the time that I was staying out of Viet Nam, thanks to having that job. So that would all be '65 and '66.

We have a long ongoing job.

Q. What was the next job after that, that you recall?

A. Well, I would be doing others simultaneously with it. Some of these overlap. Well, I'm sorry, I'm forgetting EG&G. At EG&G I did weather map transmission programs on the DDP-116, and my very last job at Adams Associates was doing the communications concentrator for Metanet, GE Metanet, on the DDP-516 and DDP-116.

Q. What are the DDP-516 and DDP-116?

A. At that time there was a company called Computer Control Company that was the local Boston competition to the Digital Equipment Corporation, and in 1966 or 1967 it was purchased by Honeywell and became the computer control division of Honeywell.

Q. Do you recall any other programs which you worked on at Adams Associates?

A. There were others but -- I wasn't prepared for this question. I don't remember, other than there were more.

Q. I believe you stated previously that you were with Adams Associates until May 1967?

A. Correct.

Q. What did you do after that?

A. Went to Seattle and formed a company Icon, spelled I-c-o-n, Inc., with two high school classmates.

Q. When was that?

A. Well, the company incorporated in July of 1966, but I didn't come out and we didn't therefore make the company fully active until May of 1967.

Q. What was your position at Icon, Inc.?

A. The three of us were equal owners and we just rotated titles. I generally don't remember which title I took the first year.

Q. Who were the other two owners?

A. Bruce Bradburn and Patrick Mullarky.

Q. How long were you with Icon, Inc.?

A. That has to be a complex answer because we sold Icon to Synergistics and it became the Icon division of Synergistics and then later we bought Icon back and it became Icon Corp. and then I finally left Icon Corp. in 1975.

Q. Is Icon Corp. still in existence?

A. Yes.

Q. What type of work did you do when you were with Icon, Inc.?

A. Mostly software and some hardware, and management.

Q. Did you write any programs?

A. Yes, many.

Q. Do you recall what some of those were?

A. Well, the two primary ones in the beginning of Icon were essential to its business as an on-line system for talking up to a thousand touch tone terminals on the line simultaneously and capturing data, and then the other primary program was a very large universal payroll program, and then all the ancillary programs to flesh out a full system.

Q. What was the first program you worked on at Icon?

A. Icon was a real bootstrap. The very first program I had to write that Icon was an assembler for the computer

because we didn't have an assembler.

Q. Did you have a computer?

A. Just barely. We had a little 4KDDP-516 and the 4K of memory was too small for Honeywell's assembler to work in so I had to write my own assembly.

Q. What was the next program that you recall at Icon?

A. An editor, an on-line editor, so that I could edit programs.

Q. On the DDP-516?

A. Correct.

Q. What was the next program after that?

A. A program called Qic. It was an interactive debugger and then the next program would be the beginnings of that on-line touch tone telephone processing program.

Q. Did you write any game programs at Icon, Inc.?

A. Certainly not in the early days. It was all business.

MR. WRIGHT: Before we proceed I will ask the reporter to mark a copy of the Notice by which this deposition is being taken as Exhibit DO.

(Notice of Deposition marked Defendant's Exhibit DO for identification.)

MR. WRIGHT: Q. Mr. Drumheller, what did you do after you left Icon, Inc.?

A. For a year I went on vacation. I did that in a very peculiar manner. I went to work for the distributor of Microdata Reality Computers in Seattle as a programmer and I laid down as a condition to him that I would accept no management responsibilities.

Q. Are you saying then that you worked for Microdata Reality Computers for a year?

A. Well, I know that sounds -- First, no, I worked for this dealership which is truly an independent dealership and that's important; and then, secondly, it was very frustrating to them because that dealership was a new company and a very fast growing company and was desperately looking for good management to grow its company.

So that entire year I was eternally being pleaded with to please come manage the applications software side of the business, and I refused to. But finally after a year I finally got tired of that and an opportunity came along to form a business partnership with the owner of that business and the ex-product manager of Microdata Reality to go design and build a whole new computer, which we called Devcom, Inc.

Q. Would you spell that for the record, please?

A. Yes, D-e-v-c-o-m.

Q. When was Devcom, Inc. formed?

A. In May of 1977. Technically May of '77 is when we shook hands as people. I believe September 1, 1977, is when it was incorporated.

Q. I think you said you left Icon in 1975. What part of 1975 was that?

A. Very late fall.

Q. With whom did you form Devcom, Inc.?

A. The specific names are Rodney Burns, Jr. and Wallace A. Haagaurd. Haagaurd is spelled H-a-a-g-a-u-r-d.

Q. How long were you with Devcom?

A. Until October of 1982.

Q. What did you do at Devcom?

A. Software primarily and then of course some management and sales.

Q. What did you do after you left Devcom in 1982?

A. I am currently under a three-year, very strong non-compete clause and I cannot be involved in the computer industry for three years. They nailed me to the wall.

Q. Under what circumstances did you leave Devcom?

A. We sold out to Prime Computer, Inc.

Q. Since leaving MIT have you written any game programs?

A. Sure.

Q. What were those?

A. Well, the first primary one was a pool game.

Q. When did you write that?

A. Late summer of 1966.

Q. Where were you when you wrote that game?

A. Employment?

Q. Yes.

A. Adams Associates.

Q. Was this part of your employment with Adams Associates?

A. Yes.

Q. What other games have you written?

A. That's what I have been trying to remember. There are others. Twenty years is a long time.

Q. Why don't we move on. Maybe we'll come back to this later. Something may or may not come to mind.

A. Yes.

Q. Would you describe the pool game which you wrote, please, in the later summer of 1966?

A. Okay. A company called IDI that made displays came to Adams Associates and wanted a demo and just by sheer coincidence two days prior, and I remember it because of the coincidence, just on my own, toying as a mathematician toying with the idea of games, I had figured out how to make balls bounce without computing any sines and cosines.

So, in other words, one could do it quickly. So when this opportunity came up I instantly raised my hand and said, "Hooray, I'll do a pool game."

Q. I believe you referred to a company called IDI.

A. Information Displays, Incorporated, of New York.

Q. You said that they wanted a demo. What do you mean by a demo?

A. They wanted something that would show off their display, be catchy, but they left it up to us as to what that would be.

Q. Did you then write a program for a pool game?

A. Yes. The equipment they had was their display that they made and an interface that they made to a DDP-116 computer. So the bulk of the job was getting to know the DDP-116 computer.

It turns out that at that time I was the only fellow in Adams Associates that knew the DDP-116 computer because I was at that time doing the job for EG&G with the 116.

Q. Do you recall the specifications of the DDP-116 computer?

A. Oh, yes. The irony is that the DDP-116 became the DDP-516, became the Honeywell 716, a spinoff of all these people became a prime computer with the exact same instruction set and my Devcom that I just sold in 1972 all these original programs were run on it.

Q. What was the word size?

A. Of the 116? It was 16 bits.

Q. How much memory did that computer have?

A. The one at IDI either had 4K words or 8K words and I don't remember, but that computer only came in those two sizes.

Q. Do you recall the display which IDI made at the time?

A. Yes.

Q. Would you describe that, please?

A. It was essentially a custom built display. Externally physically it looked like a cabinet, about a man-high cabinet, with a table top coming out, and a large tube that pretty much filled a 19-inch rack horizontally. Therefore, I guess it was probably certainly a 21 and I would guess a 25-inch diagonal tube.

Q. What type of tube?

A. I had no way of knowing.

Q. Was it a cathode ray tube?

A. Oh, I'm sorry. Yes. And then a lot of electronics in the bottom that then interfaced onto the 116. That would be the physical view. My view as a programmer to use all of this was from the 116 and what it looked like programmatically, and it was a very simple display. There wasn't anything

very fancy about it, other than the interface between the computer and their, call it black box, electronics, was nice and it ran off of DMA so I could put a display, I could put everything about the display in the computer's memory and then this box, as a programmer having to do anything, pull that out and display it.

Q. You made reference to both an interface and a black box. Are they two separate units or two different names for the same unit?

A. That is one word. I suspect the electronic engineer at IDI thought of them as two halves of his box.

Q. Mr. Drumheller, in one of your previous responses you used the term "DMA." What is that term?

A. Direct memory access.

Q. Did the program which you wrote for IDI utilize the display?

A. Sure.

Q. In what manner?

A. It was the point to the demo. What I wrote for them were two demos. One was a silly little dumb one and the other one was this very successful pool game.

Just to get the dumb one out of the way, I made a little dumb demo that would display horizontal lines and then would at random, both in XY position and in rotation throw out little sticks that were precisely the same length as the vertical distance between the lines.

Q. When you say throw out little sticks, what do you mean?

A. On the display it would appear as a line.

Q. Where would these lines appear?

A. As if someone were randomly throwing straw at the front of the screen.

Q. What determined where these lines appeared?

A. I wrote a little random number generator inside the program. Hopefully it was deciding the rotation and deciding where to throw the X and Y, and in theory the ratio of the number of those sticks that hit a line versus the number that missed completely should equal pi.

Q. Why is that?

A. You work it out in the math, and I found at the time when I was making this demo I had seen that in probably the Martin Gardner or somebody's little puzzle book, this cute little fact. It is a very interesting fact but it makes a terrible demo.

And then last but not least, my little random number generator had a bug in it so right at the show where this was being shown I had to reach in and fix this random generator because it wasn't coming up with pi.

Q. What was that show?

A. The fall joint computer conference at San Francisco in 1966.

Q. Did this first demonstration program involve any interaction with a person?

A. None.

Q. How was operation of the program begun?

A. Very crudely. Effectively there were two programs,

this dumb demo and the pool game, and you had to start the program by punching a starting address at the console of the 116.

Q. Could you select either program in that manner?

A. Yes.

Q. What terminated the running of the program which you have referred to as the dumb demo?

A. Hitting the stop key on the computer.

Q. Was there any way to control the speed or rate at which the sticks were thrown?

A. No.

Q. Did the pool game program also involve a display on the screen of the cathode ray tube?

A. Yes.

Q. Would you describe the appearance of the game on the screen?

A. Okay. It was as if you were looking down from on top of a regulation pool table with six pockets, one in each corner and one on the top and one on the bottom, in the middle, and then there was a rack of 15 balls and then there was a cue ball set on the other side, and then above the pool table were two scores because it was a two-player game.

In the very top left corner was a little logo, something to the effect "Play Pool With IDI," and then at the Fall Joint Computer Conference, then, in the lower right corner was a "Programmed by Adams Associates," and if it was at the start of a player's turn there was also a little cue stick displayed.

Q. What do you mean by the start of a player's turn?

A. Well, the logic of the game basically was-- the primary loop was, "Are there any balls moving?" If any balls are moving, then the cue stick would go away and it would play out the physics of balls bouncing around the table.

The moment the balls all came to rest, it would then go back to assuming that i's the next player's turn. So it displayed a little cue stick and it would wait for him to hit the cue ball.

Q. Mr. Drumheller, would you please make a drawing of the pool table and balls as you've just described them?

A. Yes. I don't remember the precise dimensions but I remember at the time going and finding out what the dimensions of a pool table are, X and Y.

The pockets were there (indicating).

Q. When you say those lines right there, you're referring to the lines that were drawn across the mouths of the pockets?

A. Correct.

Q. Why don't we start over.

I believe you indicated before or referred to some pockets being at the top of the display.

A. Right. By that I mean the top of the table. Like that one right there. Whereas versus the one in the corner. Right over here.

Q. And by "that one right there," were you referring to the side pocket toward the top of the page which you are now drawing?

A. Correct. That's what they're called, side pockets,

right.

I don't remember exactly what I wrote up here as being for player A and B.

Q. By "up here" are you referring --

A. At the top. Above the pool table I would have a player A score and a player B score.

Let me put all this in quotes because I don't remember the precise words I used there. It could have been "Score A" or it could have been "player A." I just don't remember the words.

Then there was a logo up here about IDI. There was a logo down here about Adams Associates, and if it was a player's turn, I will put a little cue stick right here was displayed.

Q. Would you label the cue stick and the cue ball and any other elements that you have drawn there?

A. Balls.

Q. Now, the element that you have just labeled 15 balls, is that the rack of 15 balls that you previously referred to?

A. Correct. The program didn't think of it as cue ball and 15 balls, though, except for one peculiar little thing. The program is written as if it were 16 balls in a 16-body physics form.

Q. How did the balls appear on the display? What was their shape?

A. Essentially as a round ball but, in fact, they were made up of little vectors because that's all that was available. I could either display points or vectors. Those are the only two things that is the interface between the computer and

the IDI interface would allow me as commands.

Q. Did the balls appear in different colors?

A. No, no. They were all the same color, but what I don't remember is whether I numbered the balls or not. As hard as I stretch my memory, I cannot remember.

Q. Was the display a monochrome display or was it a color display?

A. I did not use color in any significant manner. My memory is that it was not a color screen, but I am not really sure.

In any event, I did not employ color as accomplishing anything for the game.

Q. Would you describe the cue stick as it appeared on the screen for us, please?

A. It was just a little long rectangle.

Q. When was the cue stick present on the display?

A. Well, whenever the program thought it was someone's turn and it knew that because all the balls were at rest.

Q. Where did the cue stick appear when it was on the screen?

A. On the initial rack-up it appeared to the left of the cue ball.

Q. Was it spaced away from the cue ball as you've shown it on this drawing, which we should mark as Exhibit DP.

A. I am not remembering exactly what I did with the cue stick in terms of particularly after the first time you hit the balls as to where it appeared, and there's a reason why

I am not remembering. The cue stick wasn't really the way you hit the cue ball. It was just esthetic. Almost all users, all the ones I saw, would, indeed, take a light pen and hit the cue stick and drag it around, but unbeknownst to the user that was an interesting side effect that had nothing to do with the game.

Obviously, it has a lot to do with how a user perceived the game, but the actual physics of the game was controlled by how the light pen hit the cue ball as it entered the cue ball and as it left the cue ball, and how long it took for it to enter and leave the cue ball and the inverse of that time was how fast the cue ball would take off, and the vector defined by where you entered and where you left the cue ball defined the direction the cue ball would leave and the extent to which that vector misses the center of the cue ball defined the English on the cue ball.

Q. You made reference to a light pen. Would you describe that for us?

A. Yes. It was what I would call the standard light pen. I don't recall it working any differently than any other light pen I've used in probably 50 different installations.

It was a little stick like a pen with a wire coming out of the back into the machine and as a computer programmer I could enable or disable it as an interrupt, and if enabled, if I was displaying something on the scope and if the light pen was right in front of that thing being displayed, then I would get an interrupt back to the computer, telling me that the light pen had seen that object.

Q. Could the light pen see any of the objects that you have drawn on Exhibit DP?

A. Well, that was under my programmatic control. In this game it could see the cue ball and it could see the cue stick and that's all. I always had everything else disabled.

Q. I believe you said there was a wire back to the machine from the light pen?

A. Correct.

Q. Where was that connected?

A. Well, back into what we're calling the black box, and then what the light pen would give me is one of two things. I don't remember how this display worked but it doesn't make any difference. Either it gave me its pointer, its DMA pointer, back to the display list in memory saying that thing that you have in memory is what I was displaying when the light pen saw it, or it gave me a XY coordinate. And I don't remember how this machine worked.

Q. Was a person playing the game able to move any of the objects with the light pen?

A. Sure. It was a real game of pool.

Q. What could the player move?

A. Well, what the normal player would do would be to with the light pen move the cue stick around and bring it forward and hit the cue ball. If you knew that that was a fake you just would do the same thing but with the light pen.

You would take the light pen and hit that cue ball and, having hit it, it would then take off and do all the physics of a pool game, bounce off the sides or what-have-you and when it

hit the rack of balls finally the great bust-up would happen and all the balls would bounce around and then slowly come to rest.

Q. Now, when you say you could hit the cue ball directly with the light pen, what do you mean?

A. If you wanted the cue ball, for example, to go from left to right on our picture, you would hold the light pen to the far left of the picture and drag it through the cue ball and that would send the cue ball off to the left.

Q. What would the cue stick do during that time?

A. If you had first touched the cue stick then the cue stick would always be displayed right underneath the light pen. So it looked as if you were moving the cue stick, and it looked then as if you were moving the cue stick up and hitting the cue ball. So to someone not the programmer of the game, you think you are hitting the cue ball with the cue stick which is the whole visual illusion that's the point to the game.

Q. Just to make sure that I am understanding you correctly, are you also saying that it would be possible to bypass the cue stick?

A. That's correct. I as a programmer would.

Q. In that case what would the cue stick do?

A. Just sit wherever it was I displayed it.

Q. Would it remain on the screen after the cue ball began moving?

A. No. The moment I saw the light pen exit the cue

ball then, as a programmer, I no longer-- Now, we were now in the physics side of the game. So I would at that point-- I know I did two key things: First of all, I turned off the dislay of the cue stick wherever it was. Just, "Go away."

And the other thing I did is I would tell the user which player's turn it was by displaying his score brightly. I would reset that back to them.

Q. What determined the orientation of the cue stick?

A. It would always aim at the center of the cue ball. Whenever the light pen sought I would center the cue stick right under the light pen and aim it at the center of the cue ball.

Q. Was it possible to aim the cue stick anywhere but the center of the cue ball?

A. No.

Q. But it was possible to move the light pen other than through the center of the cue ball, wasn't it?

A. Yes. You could move the light pen. It was in your hand. You could do anything you wanted with it. But if you used the light pen and looked at other things, the light pen was disabled so nothing would happen.

Q. How was the light pen able to recognize the cue stick?

A. Well, it's sort of how does the light pen work. What the program sees is that a light pen interrupt has occurred and then, as I say, either I got back a pointer to my own display list, in which case I would just go look-see if that is what was pointing at my display list for cue stick or it was pointing at my display list for cue ball or I got an XY

coordinate back, in which case I'd have to go look to see if that was XY for the cue stick or XY for the cue ball.

Most light pen computer interfaces give you XY which is not, in fact, the most useful thing to get back.

Q. What determined the movement of the cue ball after it appeared to be hit by the cue stick?

A. Well, then we went into what I call the kernel of the pool game and that was just an iterative process of doing the physics of this. There were let's call them 64 registers. There would be 16 X coordinates, 16 Y coordinate registers, 16 X velocities and 16 Y velocities.

Q. Why the number 16?

A. Well, because there are 15 balls and one cue ball, so 16 balls; and it would just iteratively add these little incremental velocities to XY's and update these velocities, i.e., reduce them by friction, and then go through a nested loop looking for collisions to see if any ball is hitting any other ball or if any ball is hitting the wall or any ball has fallen in the pocket.

Q. What determined the direction in which the cue ball moved when it was hit by the cue stick?

A. Well, I would get two strikes on the cue ball, one as the light pen entered the cue ball and one as it left it, and those two points define the vector from which I would compute the velocity X and the velocity Y for the cue ball.

Q. So that those two points determined both the direction and the speed?

A. No. The magnitude then was determined by the

inverse, of the amount of time that it had taken for the light pen to traverse the cue ball.

Q. By the magnitude, what are you referring to?

A. The magnitude of the velocities.

Q. Did you also indicate that it was possible to impart English to the cue ball?

A. That's correct.

Q. How was that done?

A. Well, where you entered the cue ball versus where you exited it, if that vector didn't fall through the center of the cue ball, for example, if you just grazed the side of the cue ball, then at right angles to that vector defined the English; i.e., how much spin on the cue ball.

Q. Was that English or spin utilized in this program?

A. Yes, and to the very best of my memory, only on collisions and for sure it stayed with the cue ball. English would not transfer to other balls. That I remember for sure.

Q. Did the cue ball always appear to travel in a straight line?

A. That's the question. To the best of my memory, yes, it was. It was only when it hit a wall or hit another ball that it would take off at a funny angle if it had English.

Q. By a funny angle what do you mean?

A. Not a pure angle reflection. I would have to show you the mathematics of two balls hitting. Against a wall is the obvious one. If the cue ball hit a wall normally it would reflect with an equal angle, which is simply to say that you reverse the sign of either the velocity X or the

velocity Y. If it had English the angle would be either greater or lesser depending on the direction of the English.

Q. What happened when the cue ball touched another ball?

A. Well, in terms of this English, the same little algorithm of -- English looked like a little more friction. It was already doing this friction calculation. In other words, just add some more for the cue ball for English.

When a cue ball hit another ball the program didn't particularly know that it was the cue ball. So the real answer is when any ball hit any ball,one then went through a calculation about how to change the velocities, both X and Y,of both balls.

Q. Did it make a difference whether the two colliding balls were both moving or one was standing still at the time of the collision?

A. No, though that was one thing you had to be careful about the math, to make sure that was a true statement; but no, the calculation didn't care.

Q. When the cue ball was shot so that it appeared to hit or touch another ball, what did the other ball do?

A. It would begin to move.

Q. What determined how it moved?

A. Let me show you in this little calculation.

Q. Mr. Drumheller, you have just produced a sheet of paper with some drawings.

A. Hen scratches.

MR. WRIGHT: Why don't we mark that as Exhibit DQ so that we'll know what we're talking about.

(Drawings marked Defendant's Exhibits DP and DQ for identification.)

MR. WRIGHT: Q. What is this document that we have just marked as Exhibit DQ?

A. My resurrection last night of the mathematics I used back then. Specifically the answer to your question of what did I do when two balls hit at some random direction and velocity. .

Q. Referring to the document which we have marked as Exhibit DQ, would you tell us what did happen?

A. Well, the central concept is specified by my cryptic note here.

Q. Which note is that?

A. This rotate, swap the delta X's, then rotate back.

Q. What does that mean?

A. Rotate it, cram it. What one would do is one knew the XY coordinates of both balls and one knew that they were approximately one diameter of a ball together because that's how the collision logic was triggered to jump off and do this calculation; and you knew the velocities of both balls. But the physics of what to do given that picture where the balls are at any old funny angle is not at all clear.

Q. Are you referring to the diagram in the lower left-hand corner of the exhibit?

A. Correct. Well, the rules we want to obey is we want to conserve momentum and we want to conserve energy. It turns out the easy way to do this is to rotate the balls or rotate your coordinate system so that the Y axis is the

tangent vector between the two balls.

Q. Are you saying there that you rotate the two balls so that the tangent vector would extend in a vertical direction?

A. Correct.

Q. As you have shown in the drawing at the top of the page?

A. At the top, and once you have done that, then the physics are simple; and by rotate, that transformer by a new X equals the sine of the old X plus cosine of the old Y and the new Y is minus sine of the old X plus the cosine of the old Y.

Look it up in the textbook.

Other than that sine and -sine is important to the calculation because we mustn't in the end compute sines and cosines or we're never going to get done in time. But once you've rotated this picture this way, so now it looks like this, then the physics is very simple. You simply swap ball one's delta X for ball two's delta X and vice versa.

Q. What do the delta X's represent?

A. Well, the velocity X and the velocity Y for each of the two balls.

Q. At what point in time?

A. At what point in time. I don't understand the question.

Q. Would this be the delta X and delta Y prior to the impact?

A. Oh.

Q. After the impact?

A. I don't know which way my program did it. You are right. One of those two. The eye would never see the difference in that question. And then you have to rotate them back.

Well, in fact, you don't rotate-- When you actually do the computations, you don't rotate the balls like I have drawn here but rather what you are rotating are these velocity vectors.

Q. When you say you don't rotate the balls, are you saying you don't change positions?

A. Mathematically. Well, even mathematically. So, for example, as I just said, a new X is a sine of an old X plus the cosine of an old Y. that is not, in fact, what I would compute because all I want to do is swap these velocities.

What, in fact, I would do is take the sine of the new X velocity and the sine of the old X velocity plus cosine of the old Y velocity, which is a difference, a prior position of the ball minus the current position of the ball or vice-versa.

That's relevant because now there's no real origin. So it doesn't matter that one ball is centered in one place and the other ball is centered at the other and the real origin as I have drawn it in the picture here is halfway in between. That isn't what I was rotating. What I was rotating were these velocities.

Now, that sine and cosine, what was important to make life go quick, is that if we carefully arranged the scaling of how we kept the X's and the Y's and delta X's and delta

Y's, so that the diameter of a ball was one unit, this rotation is that angle, so sine of that angle is this distance, which is just simply Y-2 minus Y-1, a simple computer subtract, over the hypotenuse, but the hypotenuse we arranged to be one so the sine of theda is just the simple subtract.

Q. Would you label the quantities that you have just referred to there?

A. The definition of theda, definition of angle.

Q. You also referred to a Y-2.

A. This is ball two. So the coordinates are X-2, Y-2 and this is the ball one so these coordinates are X-1 and Y-1.

Q. You are referring to the drawing in the lower lefthand corner of Exhibit DQ, are you not?

A. Correct.

Q. Referring back to what an observer would see on the screen of the display, what would happen if one of the balls hit one of the sides of the table?

A. Well, in that case it was easy, easy enough so I did it as a different calculation, because there you don't have this rotation problem.

Q. What would a person seeing the screen see?

A. Oh, I'm sorry. On the screen he would just simply see the ball reflect. So, for example, if the ball hit the top wall he would see the Y velocity change sine. So he'd see a ball going up at an angle and then come down at an angle, still going in the same X direction but going down instead of up.

Q. I believe you also said that on occasions the balls

would enter the pockets?

A. Right.

Q. What happened then? What did the observer see?

A. In my game they just, pop, disappeared, and his score was incremented.

Q. How long did the game continue?

A. Until there were no balls on the table.

Q. Did the cue ball ever go into a pocket?

A. Of course it could go in a pocket.

Q. What happened then?

A. I cannot remember whether I reset the cue ball back on the table or not or whether I declared that a scratch, end of game. What I do remember is that as I went from Adams Associates down to IDI, if the cue ball went in the pocket that just scratched the game. I do remember the engineer down there giving me a very bad time about that. He said no, it is not a good game of pool.

Q. When you say you went from Adams Associates down to IDI, what do you mean?

A. Okay. The way I programmed this was I was simultaneously doing another job for EG&G for the same computer and in those days we used to keypunch programs on IBM cards and Adams Associates had a keypunch in its basement.

So I would keypunch programs for both EG&G and for this game and then I would go over to Framingham from Bedford to Computer Control Company and submit these decks of cards and get back a listing on a paper object tape, and I attempted to get this program, this pool game program, as complete as

possible. Then on a Monday, I think, I flew down to New York, just north of New York City, to Information Displays, Incorporated, rented a motel room and just lived there through the next Sunday, because once down there I could no longer get a new listing or reassemble the program.

So I went down there with this paper object and the last listing and a debugging program and I debugged the program and would patch it, dump memory back out on paper tape.

Q. How long had you worked on the program before you went down to New York for that week?

A. I don't remember precisely but it was not very long. Two to three weeks. Less than a month.

Q. What did you do while you were down at IDI?

A. Debugged and polished and added to this program.

Q. I believe you referred to it as a machine previously. Did it have any other controls besides the light pen, any other control devices?

A. The display did not. Since I was controlling it from the DDP-516 computer, the DDP-516 had some sense switches on the console and I did use one of those to control my program which then instantly controlled the display so a user would say the sense switch was controlling the display.

What I used the sense switch for was to control friction in its normal setting for its normal friction.

In the middle position there was no friction. In the up position there was negative friction so all the balls would get to going faster and faster.

Q. What would happen when the balls went faster and

faster?

A. Yep. We all did that once. Eventually one ball would just go splat into a wall and stick and I assume some sort of overflow arithmetic in my calculation. It would just sit there and vibrate very fast, stuck in the wall like mud.

Q. There wasn't a quick way to run the table, then?

A. No.

Q. Why did you incorporate the negative friction into the program?

A. Just for this fun.

Q. Do you recall the improvements that were made during the week that you were at IDI?

A. Well, it is that very question about reracking a sunk cue ball that I think is the bulk of what I did down there, but I just don't remember. Well, I guess it would be like Monday through the next Sunday. I remember putting a lot of work on the program down there.

Q. Do you recall when this week was?

A. Not precisely. The only way we can pin it down precisely is because that Sunday we shut the whole thing down and put it on the truck. I helped load it on the truck in New York, and it then came across country and the next Thursday, I believe, was set up in the Cow Palace here in San Francisco for the fall joint computer conference of 1966.

Q. What was put on the truck that Sunday in New York?

A. The DDP-116 computer and this display.

Q. Had the program been operated at that time?

A. Yes.

Q. When was it first operated?

A. Well, within a day of my being down there. So I would say Tuesday, at the latest Wednesday, of that week.

Q. Did the program operate successfully by the time the truck left for San Francisco?

A. Yes.

MR. WILLIAMS: Objection. Vague.

MR. WRIGHT: Q. Do you recall who saw the program operating during that week before the machine was shipped to San Francisco?

A. Yes. They would all be employees or the owner of Information Displays, Incorporated. So one was Mr. King who was the president and owner. Another person was the sales manager. All I can remember is his name begins with a "W" and the third was the lead electronic engineer. I don't remember his name. I remember his having a large beard.

Q. In what form was the program installed in the computer?

A. Paper tape.

Q. Did you attend the fall joint computer conference in San Francisco?

A. Yes, I did.

Q. Who else attended?

A. Adams Associates as it turned out sent out about a dozen. About a third of the company came out, and spouses. So my wife came out although she had to come out a day later than I came out because she was a school teacher back

in Yardsborough School District.

Q. Which year was this conference? I believe you said it was a fall joint computer conference?

A. Correct.

Q. What year was this?

A. It is going back but it is going to be 1966.

Q. Is there a way that you are able to identify that year?

A. Yes. The primary way that I know it well is because that's one year that my wife was working at -- I just said it. Anyway, she was a high school teacher. Acton. And when she was out here we for the first time in our lives did that cheat of calling long distance back to her employer and declaring that she was ill. A very memorable cheat in my life.

Q. Did IDI have a booth at the conference?

A. Yes.

Q. Did Adams Associates have a booth?

A. Yes.

Q. What type of people attend a conference of this type? More specifically, what type of people attended this specific conference?

A. The two primary types of people are university people and vendors.

Q. Is the conference open to the public?

A. Yes. And of course to some extent customers come.

Q. Did you see the IDI booth at the conference?

A. Yes.

Q. Would you describe that booth, please?

A. It was a small booth and it just had the DDP-116 in it and their display which is a box almost the same size sitting right beside it and really not much else in it.

IBM that year took the whole center pavilion of the show and IDI's booth faced across the aisle at the IBM booth.

Q. How large was the IDI booth?

A. Six or eight feet across.

Q. Was there any equipment there other than the computer and the display?

A. No. Perhaps a table.

Q. Did they have any sales literature?

A. Sure, and after the first day or at least after the first morning -- in fact, there was a table because after the first morning they also had great big bowls of matchbooks saying "Come Play Pool with IDI."

Q. How long did the show last, or the conference last?

A. Well, those things last three days.

Q. Was the pool game demonstrated at the conference at the IDI booth?

A. Oh, yes. It was the hit of the show. It was a very great success and all the time there was always a crowd of people around the game.

Q. Were people attending the conference permitted to play the game?

A. Yes.

Q. Do you have any idea how many people did play it?

A. I could only guess. Every time I was around there was a line of at least 30 or 40 people waiting to play it.

So to the best of my knowledge, it was played continuously for three days.

Q. Did you indicate previously that Adams Associates also had a booth at the show?

A. Correct.

Q. Did you see that booth?

A. Correct.

Q. Would you describe that booth, please?

A. It was -- since we were a softwarehouse, there was nothing to show, so it was just a pretty rug and benches, and some sales literature and then on the wall a list of customers and then after the first morning of the show the table in the middle of the booth with a television monitor showing this pool game.

Q. What do you mean by a television monitor?

A. Whatever the monitor was, it was the same as the one that was at the airport at that very same show. Jack Gilmore who ran Adams Associates saw that this pool game was going to be a really big hit and so he had me the first morning of the show add this Adams Associates logo to both of the displays and he went off to another booth in the show have some folks whose business it was to make monitors and got them to hook up a monitor, several of them, and one of course in his own booth.

Q. Now, you say they were hooked up. To what were they hooked up?

A. I did not see what they hooked it to inside, but all I watched and saw was that they ran cables like standard black coaxial cables off to these monitors and they ran down and into

the insides of IDI's display, what we've been calling the black box.

Q. Where were the monitors located? I believe you said that there was one in the Adams Associates booth.

A. Correct.

Q. Do you recall where the others were?

A. The other one that I very explicitly remember was then simply set on top of the DDP-116 computer and they put it up high enough so that this whole crowd of people trying to watch this game could then, instead of having to look through the head of the guy who was playing the game, could watch the whole game.

Q. Was this on top of the DDP-116 computer in the IDI booth?

A. Yes, and then my memory is that there was another one at the monitor company's booth, and I seem to remember there were others, but I don't remember precisely where.

Q. Do you know the manner in which the picture was generated on the screen of either the IDI display or the monitors that were connected to the black box?

A. The monitors were very clearly like a home television set. So scanning. You could see the grains and what do you call that horizontal reading?

Q. Is that word "grainings," did you say?

A. That's what I call it. That is a wrong word because graining means boxes and I mean lines. The IDI scope I do not know.

Q. When you used the term "scope," what do you mean?

sales literature which referred to the pool game?

A. IDI at least for sure after the first morning handed out matchbooks whose sole purpose was to promote the pool game.

Q. Do you recall whether the pool game received any coverage in the news media at the time of this conference?

A. Not that I ever saw.

Q. Are you familiar with any other electronic pool games, Mr. Drumheller?

A. Yes. In fact, at that fall joint conference I got hit up, if you will, by a friend claiming I had plagarized his game. To the best of my recollection, his name is Edwards. I can close my eyes and see him but it's been too many years to be sure I have got the name right.

And he was one of the graduate students at MIT working with Professor Minsky, and according to him during those same weeks the fellows down on the PDP-1 in building 26 had likewise made a pool game.

Q. By "those same weeks" --

A. That I was programming mine. So the prior month to this fall joint computer conference.

Q. Were you aware of any such programming at MIT?

A. No, no. So there was a very interesting "You stole mine, I stole yours" conversation went on, when in fact I happened to know that at least from my side it was honest to golly independent.

Q. Did you ever see the pool game or the program--

A. No, I did not, but I heard about it not only from Edwards but also from Bill Gosper. And I should add, by the

way, to the very best of my knowledge and belief that they did not plagarize it from me either because I don't think they had any way of knowing that I was quietly off in the evening doing this.

Q. Have you become aware of any other electronic pool games?

A. I have been told by you people that in a similar period of time someone at RCA also developed a pool game at that same time frame. I am a little curious if that one is truly independent because, as I have said, the two nights before the IDI people came I discovered this little piece of mathematics and did it at my home with my nextdoor neighbor, a fellow named Ted Kupfrian who worked for RCA. So I have to wonder if the grapevine didn't pass it along.

Q. After you wrote your pool game program, are you aware of any other pool games that were written?

A. Well, the obvious one that then later IDI had called me to do that same game again for a different computer. At that time I was too busy so my brother-in-law, Patrick Mullarky, reprogrammed it and like any good engineer added his own polishes and touches and changes.

Q. Do you recall when that was?

A. Yes. It would have been the fall of 1967 that IDI contacted us to do that.

Q. How do you fix that date?

A. Because I came out to Seattle in May of 1967. And there's kind of an irony: we did that job for a thousand dollars. It wasn't any particularly good business deal,

but Pat was free at the time, and there was perhaps some prestige in it.

Q. Were you in Seattle at the time that this was done?

A. Yes.

MR. WRIGHT: Why don't we take a short break at this point.

(Short recess.)

MR. WRIGHT: Q. Mr. Drumheller, do you know approximately how many people attended the fall joint computer conference in 1966?

A. It was well attended. It filled the Cow Palace down here and therefore you can probably guess as well as I could. It is some tens of thousands.

Q. Are you familiar with the raster scan?

A. Yes.

Q. Were the monitors which were connected to the IDI equipment at that joint computer conference raster scan devices?

MR. WILLIAMS: Leading. Objection.

THE WITNESS: Yes.

MR. WRIGHT: Q. Do you know whether the pool program which Mr. Mullarky subsequently wrote was for a raster scan device?

A. No. It was not. It was for IDI's new product, the first real product, called Idiom, I-d-i-o-m, and it expressly was a very fancy, high speed XY, and by fancy I mean it had windowing and it had circle generators and I don't know what other things.

control to the computer between the black box and the computer trick.

Q. Do you know whether the black box provided any synchronizing signals to the display?

A. Yes. Let me back up.

In the sense of my looking at prints or something, I guess in that sense I'd have to say no. I just assumed that it did. It had to. There certainly had to be some such interplay backwards, though, because very much so I would get a frame sync back into the computer from this black box, saying it is now time to do another round of the picture.

Q. What did a round of the picture consist of?

A. Well, it is what I call a frame. On a home televion set I think it is 30 times a second, hence a whole picture on the screen. Let me call that a frame. Then it expressly waits for a sync pulse, which is a timed thing, and then does another one.

This IDI thing did the same functionality of painting a frame at a constant rate and telling me when it was about to do the next one.

Q. Do you recall what that frame rate was?

A. No, I don't. I can assure you it was more than 30 times a second because I've worked with these enough, both prior to this game and afterwards, to know that it is at about 28 that you start seeing a flicker and there's not a whole lot of value doing it much faster.

So it certainly would not have been faster than 15 frames per second and I would be surprised if it wasn't 30,

but I don't remember.

Q. Did you observe flicker when your program was operating?

A. No.

Q. When you looked at the screen of the IDI display when your program was operating, did you see individual lines in the picture?

MR. WILLIAMS: Objection. Vague.

THE WITNESS: I agree. I don't understand the question.

MR. WRIGHT: Q. By doing it before, I believe that you testified that the display which you saw on the monitors appeared to be made up of some lines, some number of lines, and my question here is, did the picture on the IDI display also appear to be composed of a series of horizontal lines?

A. The answer is going to be no, but it doesn't tell me much. If it was a raster scan like a home television set, then it must have been at least twice the number of scan lines.

But what is more to the point is that a television monitor quite often is only half a line of information and then half white and then half -- That is why you see it so much. But if you open them up to where they touch, then you can't see it. So I couldn't quickly see any such horizontal lineness.

The second problem is that neither of the demos that I was displaying would particularly illustrate the problem. You don't really see that problem unless you are displaying a 45-degree line. Then you see little jiggies, and neither

of my displays did that particularly. I guess the one where I was talking about throwing out straws, I guess that one had little 45's. It was such a dumb display we hardly ever ran it and I don't remember, again.

Q. You said something about opening something up so they touched. Do you recall what you were referring to there in your previous answer?

A. Oh, well, on a raster scan device of any form, be it television or be it a facsimile machine which is the same as I was working with at EG&G, and I was very familiar with this because at EG&G we were doing weather maps on facsimile machines and I was concerned about this issue because as you do each scan line you then advance -- you either drop the beam on a television tube or you advance the paper in the facsimile machine and you do another scan line.

And you are depositing or laying down something on a CRT. You are depositing electronics on the face of the tube and it makes for light. A facsimile machine you were laying down iron oxide, I think, or something brown, and it is important whether the two horizontal lines overlap or just touch or miss each other.

If they miss each other then there is going to be a white space in between or on a CRT tube there is a black space in between and the horizontal lines become very evident. If they just touch it can get to be very difficult to know what is happening unless you're displaying a 45-degree line and can see the little jiggies.

A. Are you then saying that it is possible to have

a raster scan display in which the scan lines are not visible?

MR. WILLIAMS: Objection. Leading.

THE WITNESS: Yes.

MR. WRIGHT: I have no further questions.

EXAMINATION BY MR. WILLIAMS:

MR. WILLIAMS: Q. Mr. Drumheller, I believe on direct you stated that the balls in the pool demonstration program you wrote were made up of a series of vectors.

A. Correct.

Q. Do you recall how many vectors made up each ball?

A. Not precisely. I would guess eight.

Q. Is it not correct that a certain number of these vectors would be at an angle from horizontal to vertical?

A. Yes, but the whole ball was so small, and deliberately, that the effect to the eye was just a circular blob of light.

Q. Did the score include any lines which were at an angle to the horizontal and vertical?

A. To the best of my memory, that silly thing only had plot appointed X and plot appointed Y and a vector. So to the best of my memory, I borrowed my numbers, bit mapped numbers from my EG&G project or program and displayed the score as a whole bunch of points which very nicely doesn't answer your question. I'm sorry.

Q. In the IDI pool demonstration program, is it correct that when the cue stick was displayed it was always pointing towards the cue ball?

A. Yes.

Q. If the person running the display moved the light

pen towards the cue ball, just in the general direction of the cue ball, was it possible for him to miss the cue ball with the cue stick?

A. The answer is yes. I mean the visual effect would be very peculiar. As he went by missing the cue ball the cue stick would turn and be aimed at the cue ball. It would look kind of funny.

Q. Where on the cue stick did the player have to touch?

A. Any part of it.

Q. Any point on the cue stick?

A. Yes, and then I would simply center the cue stick at that point.

Q. So the cue stick would be centered on the point where the light pen touched the screen and always pointing at the cue ball; is that correct?

A. Say that again.

Q. Is it correct that the cue stick would be centered on the point at which the light pen touched the screen and always pointing at the cue ball?

A. I think the answer is yes. The light pen worked the other way around. That is why I am having trouble with your question.

Q. What do you mean they worked the other way around?

A. Well, wherever the cue stick was being displayed, if the light pen saw it then the question is did the -- It's kind of the chicken and the egg problem.

The light pen, when it first brought it up and first touched the cue stick, you'd touch it at some random

place at which point, and I don't know if anybody observed it, but almost by definition the cue stick would take a little incremental jump and jump underneath your light pen.

Q. And it would jump to a point so that the cue stick was centered on the light pen?

A. Correct. That is why I am saying it was backwards.

Q. Did the player then move the cue stick by moving the light pen?

A. That was his perception, whereas in fact the reverse was happening. You were moving the light pen and the cue stick was following.

Q. Was it possible for the player to move the cue stick to the cue ball so that one end of the cue stick appeared to touch the cue ball without having the cue ball move?

A. The answer to that is no. But kind of as an accident in solving a different problem, the problem I had was since my real control was having the light pen enter the cue ball and leave the cue ball, I can remember down in New York discovering the happy bug that if the guy just grazed the cue ball they might only see an entrance and never see an exit.

So I remember having to put in a time out so that once you hit the cue ball, if after a certain amount of time they still hadn't got another light pen interrupt, you would then conclude that you had grazed the ball and defined the relevant vector.

Q. But how was it determined that you hit the cue ball the first time?

A. I would get a light pen interrupt from the cue ball.

Q. By the light pen passing through the ball? That caused the interrupt?

A. Yes.

Q. What happened if the player moved the cue stick up to the cue ball but did not move the light pen through the cue ball?

A. Then after this time out occurred I would presume that he had grazed it going at right angles to that and so the cue ball would take off in the correct direction perceptually as if you had hit it, but it would have a whole bunch of English on it that he didn't mean.

Q. What if the light pen never went into the cue ball initially?

A. Then nothing would happen and it would continue showing bright on one of the scores saying "It is your turn."

Q. So is it correct, then, that the player whose turn it was could move the cue stick up so that the end of the cue stick appeared to touch the ball and hold the cue stick there by not moving the light pen any further and the ball would not move?

A. It is a very nice theoretical question but in practice not even possible, because the cue ball was much too small and the pen was much too large and your hand wiggles.

Q. Did not the cue stick have a certain length to it?

A. Oh, yes, yes, but it was small. But yes, it certainly did.

Q. How long was the cue stick?

A. I don't remember, but one or two ball diameters.

Q. But it is correct, is it not, that the IDI pool display demonstration program in effect did not care whether the cue stick struck or appeared to touch the cue ball?

A. On my game that is correct.

Q. That's the game we're talking about.

A. Yes.

Q. And that program included no provision for determining whether the cue stick had appeared to touch the cue ball; is that correct?

A. That is correct.

Q. You referred to your dumb demo on direct, and I think you stated it appeared as though something had been thrown at the screen. What do you mean by the term "thrown"?

A. Again the philosophy was that you were looking down on, say, cracks in the floor and you were dropping straws and they were the same length as the distance between the cracks in the floor, and the reason I use that analogy is I remember reading this puzzle in a book and that's exactly how it was worded.

Q. What I don't understand is how the lines between the horizontal lines appeared. Why do you use the term "thrown"?

A. They would just appear one at a time randomly on the screen.

Q. They just suddenly appeared?

A. Yes.

Q. And they wouldn't move about after they appeared?

A. No.

Q. You said at the IDI booth at the fall computer conference there was present a computer at the IDI display. What computer was that?

A. DDP-116.

Q. Do you know what the capacity of that DDP-116 was?

A. In terms of memory?

Q. Yes.

A. It was either 4K words or 8K words, and I don't remember.

Q. Were there any peripheral devices included with the DDP-116 at that demonstration?

A. Well, a paper tape printer and a paper tape punch, and then the display itself of course wasn't a peripheral.

Q. Any others?

A. A teletype.

Q. Any others?

A. No.

Q. Do you know the approximate cost of the DDP-116 at the time of that conference?

A. I can remember at the time laughing and telling people about my $50,000 pool game, but what I don't know is whether that was everything including the display or not.

Q. So all the equipment that was at that demonstration, to the best of your knowledge, cost at least $50,000?

A. And better, would be about $50,000, yes.

Q. But you are not sure whether that $50,000 includes just the display or the entire system of the display and the computer and everything else?

A. That's correct, but as I think about it, I am pretty sure I would have meant to myself at the time the whole, including the display.

Q. You referred to some monitors used at that fall computer conference. Did you have any occasion to see the circuitry in the sides of those monitors?

A. No.

Q. You compared those monitors to a home TV set. Did you base that comparison on anything other than just observing the outside of the monitors?

A. That is correct. That's all I used in comparison.

Q. Do you have any knowledge of the circuitry which was included in the black box with the IDI display to drive those monitors?

A. The only accurate answer to that has to be a longer answer than you are expecting.

The problem is that within two years at Icon I became thoroughly involved with building those very same kind of interfaces to that very same class of computer, and so rather quickly I can project back exactly what must have been there.

Q. I don't want your projection. I want your actual knowledge.

A. That's right. So my problem is that I am not going to have a good memory as to what my knowledge at that time was. It's lost in the haze of years.

Q. That happens, unfortunately.

A. Yes.

Q. Do you recall what knowledge you had of that circuitry

at the time?

A. Well, I had not at that time become facile at the precise way Computer Control Company detailed their circuitry. So at that time I would have only understood it in a functional sense.

Q. The circuitry in the black box might have differed in the type of display that was used by IDI whether it was a XY display or a raster scan display?

A. I would certainly think so, yes.

Q. It is my understanding you don't presently know whether the IDI display used at that fall computer conference demonstration was a raster scan or an XY display?

A. No, I do not.

Q. You presently reside in the State of Washington; is that correct?

A. Yes.

Q. And this deposition is being taken in San Francisco?

A. Correct.

Q. What caused you to come down to San Francisco to have your deposition taken?

A. Flehr, Hohbach, Test, Albritton & Herbert asked me to come down and since I am retired, I actually had nothing better to do.

Q. Has anybody or did anybody in 1976 contact you with respect to the work done on the pool demonstration programs?

A. At some point Pat Mullarky told me that he was being deposed for describing this whole process, but it does seem to me that it was well after. But I wouldn't remember the year.

THE WITNESS: Trivially.

MR. WRIGHT: Q. What do you mean, "trivially"?

A. Very, very easily.

Q. You mentioned that you would like to have sold your game for something on the order of a hundred dollars. What equipment would that have included?

A. My thinking was always to make a little digital box of XY and delta X, delta Y registers and have a little paddle stick that would control the delta X, delta Y of the cue ball, and then generate a television signal that would go in the antenna. And it would just simply be the same raster scan and sync of a television. So that it would be a down counter for the raster count. And either an analog sawtooth for the X dimension or an up counter, either way, to generate the display.

And the display would just simply display these balls at the XY corners. For a home game I would have done a game of billiards simply because it has fewer balls.

Q. You mentioned a connection to an antenna, I believe. Would that be on a home television receiver?

MR. WILLIAMS: Objection.

THE WITNESS: Yes.

MR. WRIGHT: Q. And did you envision connecting this little unit that you would build to home television receivers?

MR. WILLIAMS: Same objection.

THE WITNESS: Yes, that was the market I perceived.

MR. WRIGHT: Q. When people played your pool game at the joint computer conference did you ever see anybody

impart motion to the cue ball without having the cue stick appear to touch the cue ball?

A. No, I never did.

Q. That was not a normal mode of operation for the game, was it?

A. No.

MR. WILLIAMS: Objection. Leading.

THE WITNESS: No, it was not.

MR. WRIGHT: Q. Just so the record is clear, what was the normal mode?

A. They would pick up the light pen and touch the cue stick and then you very quickly find after the first time or two players discovered that it was a real game. So you would see them cock their head just like you do in a pool game, cock their eye down the screen. Then they'd take and kick the ball, handle this cue stick, just follow the light pen.

Q. Was there any relationship between the speed at which the cue ball traveled and the speed with which the light pen was moved?

A. Yes. That was in fact mathematically called the inverse, but common sense says directly, the faster you hit it, the faster the cue ball took off.

MR. WRIGHT: I have no further questions.

MR. WILLIAMS: Just a couple of questions.

FURTHER EXAMINATION BY MR. WILLIAMS:

MR. WILLIAMS: Q. What were the paddles or paddle sticks you referred to as having been considered in these home games you talked about?

A. As an inventor, I didn't pin it down to say I was going to use that thing, but particularly in my work at AFCRS and at Lincoln Laboratories--at Lincoln Laboratories in particular--we were toying around with lots of different forms of such devices, and a very early version of the mouse, for example, I used to play with.

Q. Let me specify: Did the paddles or paddle sticks appear on the television screen or were they some control off the screen?

A. Oh, no. Something that you held in your hand. A replacement for that light pen.

Q. Did you ever build any one of these home devices that you had in consideration?

A. No, I never built a prototype.

MR. WILLIAMS: I have no further questions.

MR. WRIGHT: Why didn't you build a prototype of the home game?

THE WITNESS: Because I couldn't resolve the difference between as a marketer seeing how much I thought I could sell it for versus the common sense of how much it was going to cost. In hindsight, if I had just realized that bars and taverns were the place to put them, I would be a wealthy man. But I did not think of that.

MR. WRIGHT: I have no other questions.

MR. WILLIAMS: No further. I quit.

MR. WRIGHT: The only stipulations that we have been making are that the witness can sign the transcript before any notary and that the party taking the deposition will retain

custody of both the original transcript and the original exhibits.

Is that agreeable, Mr. Williams?

MR. WILLIAMS: Yes.

* * *

(Signature of the Witness)